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Environmental Assessment

**Red Dog Mine Project NPDES Permit Renewal
Alaska**

Teck Cominco Alaska, Inc.

NPDES Permit No. AK-003865-3

Revised January 2006

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1.0 Purpose and Need for the Proposed Action

1.1 Background

The Red Dog lead and zinc mine is located in northwest Alaska, approximately 80 miles north of Kotzebue and about 50 miles inland from the Chukchi Sea (Figure 1). The mine site is located on Red Dog Creek in the DeLong Mountains. In the early 1980s, Teck Cominco Incorporated submitted several applications for federal authorizations for the project. One of the applications was for a National Pollutant Discharge Elimination System (NPDES) permit to discharge wastewater to Middle Fork Red Dog Creek. The surface water discharge was a new source in accordance with 40 CFR 122.2. As a result, 40 CFR Part 6, the Agency's implementing regulations for the National Environmental Policy Act, required EPA to prepare an Environmental Impact Statement (EIS) on the potential environmental impacts of the proposed operation. EPA issued that EIS in 1984 (USEPA/DOI 1984).

The original NPDES permit issued to the mine (AK-003865-2) expired in 1990. In its application for a permit renewal, Teck Cominco requested an increase in the volume of effluent that it was permitted to discharge. The requested change was outside the range of alternatives considered in the original EIS and therefore raised issues not addressed in the original EIS. As a result, EPA prepared an Environmental Assessment (EA) that evaluated potential impacts of the increase in effluent discharge volume and selected alternatives (USEPA 1993). EPA subsequently made a Finding of No Significant Impact (FONSI) and reissued the permit on August 28, 1998.

The 1998 NPDES permit included metals limits that were significantly more stringent than the metals limits in the original NPDES permit. The permit also included limits for total dissolved solids (TDS) based on the State's narrative water quality criterion for aquatic life use, which limited the concentration of TDS to "one-third above background." Based on measured in-stream background concentrations, the limits were set at 176 mg/L (monthly average) and 196 mg/L (daily maximum).

Teck Cominco uses lime precipitation and sodium sulfide precipitation in its wastewater treatment process to lower the concentration of toxic metals in the wastewater. This treatment process changes the composition of TDS in the mine's effluent from a heavy metal–sulfate based TDS to a calcium-sulfate based TDS. Currently, there is no proven technology to remove TDS from wastewater at the flow volumes discharged by the facility.

The mine's wastewater essentially consists of precipitation runoff from exposed ore in the mine pit and waste rock piles. It is collected in a tailings impoundment, where it is exposed to mine tailings. The tailings impoundment water is also used in ore processing and then returned to the tailings

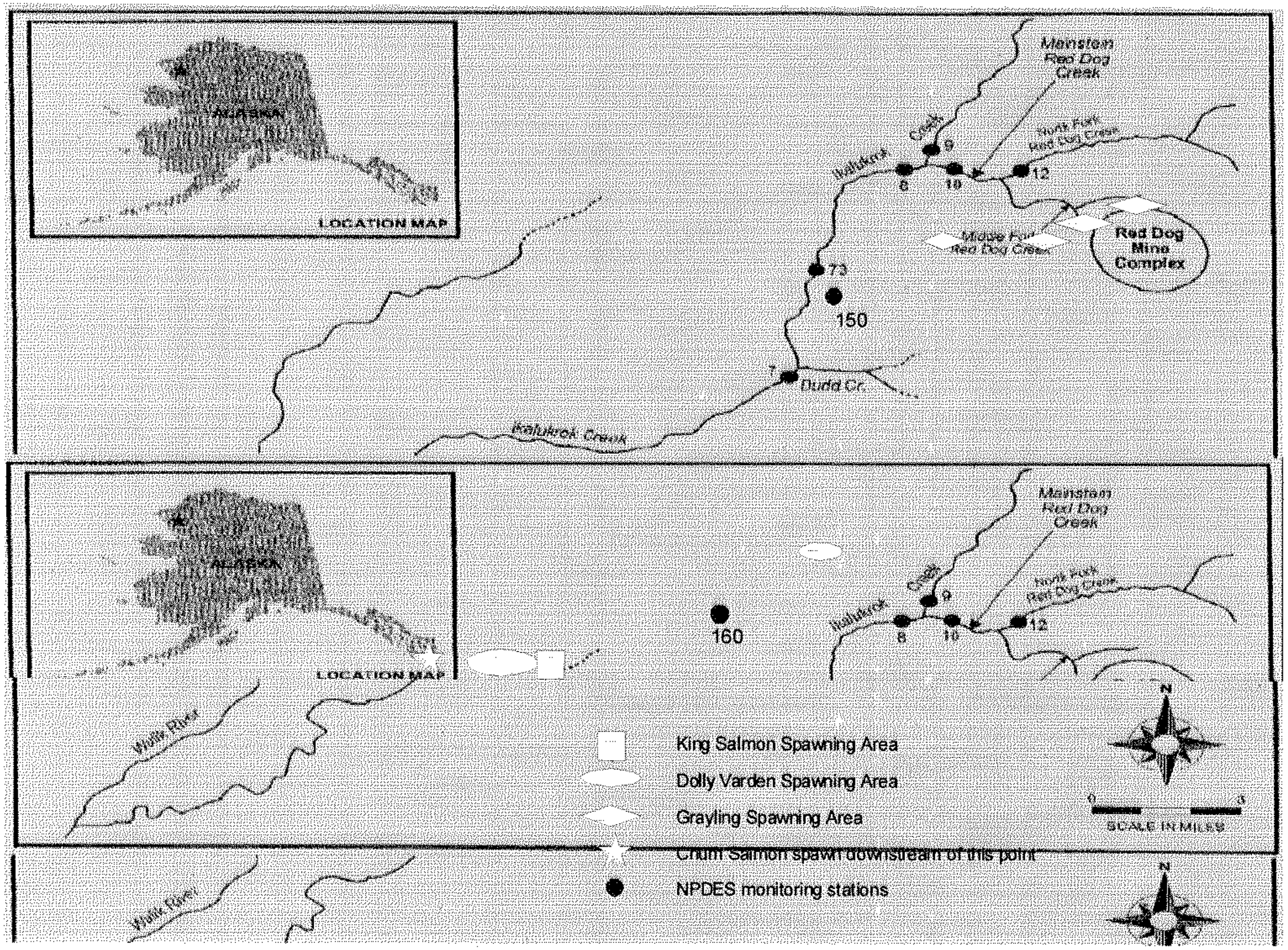


Figure 1 - Red Dog Mine

impoundment. The mine must discharge water from the tailings impoundment in order to make room for new precipitation runoff that must be captured and treated before discharge. The tailings impoundment is near its water holding capacity. Because the water in the tailings impoundment is highly toxic to aquatic life and human health, it is critical to maintain the water in the tailings impoundment at a level to ensure the impoundment's structural integrity. To do this, the mine must discharge all of the mine drainage (i.e., rainfall and snowmelt that comes into contact with exposed ore) that is collected in the tailings impoundment each year and a portion of the process water that enters the impoundment with the tailings. Teck Cominco is planning a new lift for the tailings impoundment to increase the impoundment capacity.

In 1999, the Alaska Department of Environmental Conservation (ADEC) revised its state-wide water quality regulations (18 AAC 70) to delete the "one-third above background" narrative criterion for TDS. The criterion was replaced with "not-to-exceed" limits that depend on the designated beneficial use classification. The aquatic life use classification can allow a TDS criterion value of 1,000 mg/L. However, as stated in the 1999 revisions:

> If a permit applicant proposes to raise the TDS levels in the receiving water to result in a concentration in the waterbody between 500 mg/l and 1,000 mg/l for all sources or above 110 mg/l for the potassium ion, the department will require a permit applicant to provide information that the department identifies as necessary to determine if the proposed TDS level will cause or can reasonably be expected to cause an adverse effect on aquatic life; based on its analysis, the department will limit the TDS level in the waterbody as necessary to prevent an adverse effect, and will set permit effluent limits accordingly; the burden of proof to demonstrate no adverse effect is on the permit applicant; implementation of the "no adverse effect" criterion is not subject to 18 AAC 70.235.

Table 1, below, summarizes the use classifications for each stream segment, and the most stringent TDS criterion applicable to each stream segment.

Figure 2
Mixing Zone Locations

Table 1. Use Classifications and TDS Criteria for Area Streams

Stream Reach	*Use Classifications*	*TDS Criterion for the Most stringent Use Classification*
Upper Middle Fork Red Dog Creek (Headwaters to terminus of the Red Dog mine water management system)	**Industrial water supply**	No amounts above natural conditions that can cause corrosion, scaling or process problems.
Lower Middle Fork Red Dog Creek (Terminus of the Red Dog mine water management system to confluence with North Fork Red Dog Creek)	**Industrial water supply** Contact recreation (wading only) Secondary recreation (except fishing)	No amounts above natural conditions that can cause corrosion, scaling or process problems.
Mainstem Red Dog Creek (Confluence of North Fork Red Dog Creek to confluence of Ikalukrok Creek)	**Aquatic life** Industrial water supply Contact recreation (wading only) Secondary recreation	May not exceed 1,000 mg/L; may not be present in a concentration that causes an adverse effect to aquatic life.
Ikalukrok Creek	**Aquatic life** Industrial water supply Contact recreation (wading only) Secondary recreation	May not exceed 1,000 mg/L; may not be present in a concentration that causes an adverse effect to aquatic life.

NOTE: The TDS criterion listed is associated with the use classification that is in bold letters.

In January 2001, Teck Cominco submitted a request to ADEC to establish a site-specific water quality criterion for TDS in the Mainstem Red Dog Creek. Teck Cominco requested an in-stream TDS criterion of 500 mg/L during Arctic grayling spawning and a TDS criterion of 1,500 mg/L (maximum) which would apply after resident Arctic grayling finish spawning (this occurs when there is free-flowing water after ice breakup, usually in late May or early June, when the water temperature is approximately 4°C).

Teck Cominco also requested that ADEC approve a permit limit for TDS that allows 1,000 mg/L (maximum) in Ikalukrok Creek from its confluence with Mainstem Red Dog Creek to its confluence with the Wulik River. This limit would apply at all times except during the spawning period for Dolly Varden, king, and chum salmon (species that spawn in Ikalukrok Creek, see Figure 1). During spawning periods, in spawning areas, the permit limit would be based on the TDS criterion of 500 mg/L (maximum). Spawning in Ikalukrok Creek occurs approximately 9.5 miles downstream of Dudd Creek (see Figure 1) from July 25th through the end of the discharge season (i.e., the facility ceases its discharge for the year when the creeks start to freeze up, the exact time will vary from year to year).

Teck Cominco also requested that ADEC modify its Clean Water Act Section 401 certification of the Red Dog Mine NPDES permit to include the above TDS criteria and to authorize two mixing zones: one in Mainstem Red Dog Creek and the other in Ikalukrok Creek. A mixing zone is a limited area in a waterbody downstream of the discharge, where the effluent is diluted by the receiving water. Within the mixing zone the TDS criterion can be exceeded locally due to incomplete mixing of effluent and the receiving water. Outside of the mixing zone the criterion must be met. The proposed mixing zone in Mainstem Red Dog Creek would begin at the confluence with North Fork Red Dog Creek and continue downstream for 1,930 feet. The proposed mixing zone in Ikalukrok Creek would start at the confluence with Mainstem Red Dog Creek and continue downstream for 3,420 feet (Figure 2). ADEC authorized the mixing zones in 2003.

The effluent flow volume from the mining facility outfall (Outfall 001) would be adjusted as necessary to avoid exceeding the applicable criterion outside of the mixing zone. Teck Cominco (Teck Cominco Alaska, Inc. 2000b) developed a TDS/conductivity model that can be used to adjust the outfall flow volume to meet the in-stream limit. Teck Cominco requested that ADEC modify its certification to incorporate the 500 mg/L TDS site-specific criterion for Mainstem Red Dog Creek, the 1,000 mg/L criterion for Ikalukrok Creek (except during spawning periods), and the mixing zones in Mainstem Red Dog Creek and Ikalukrok Creek.

Teck Cominco requested that EPA modify the mine's NPDES permit to reflect the changes outlined above. On July 17, 2003, EPA issued a modified NPDES permit. On the same day, EPA issued a Clean Water Act Section 308 Information Request to Teck Cominco that required tests to be performed to determine the effects of TDS on the spawning success of Arctic grayling and Dolly Varden (discussed in Section 4.2.1 of this EA). The modified permit was appealed, which stayed the grayling spawning TDS limit. On June 15, 2004, the limit was remanded back to EPA by the Environmental Appeals Board (EAB). On August 28, 2003, the NPDES permit (as modified, except for the one stayed condition) expired and was administratively extended pending its renewal.

1.2 Purpose and Need for Proposed Action

NPDES permits are written for a term of five years. After five years the permit conditions are reviewed and a renewed permit is issued based on data collected over the previous permit life and any applicable regulatory changes or changes to water quality standards. Since the Red Dog Mine discharge is a new source in accordance with 40 CFR 122.2, any change to the renewed permit that has the potential to cause environmental impacts must be assessed through the NEPA process. Only new conditions in the renewed permit with the potential to result in environmental impacts are assessed in this document. Most provisions in the Red Dog Mine's draft permit renewal have already been assessed in previous NEPA documents (USEPA/DOI 1984; USEPA 1993; USEPA 2003) and are not considered here.

Teck Cominco submitted an application for renewal of its mine-site NPDES permit on February 25, 2003, more than 180 days prior to expiration of the existing permit. EPA reviewed the application and determined that it was complete. The purpose and need for this action is to reissue the expired NPDES permit to include revised conditions based on recent data and to respond to the EAB remand order.

1.3 Scope of this Environmental Assessment

EPA has prepared this Environmental Assessment to support the proposed reissuance of the Red Dog Mine NPDES permit. Consequently, the analyses in this EA are restricted to matters directly related to proposed changes in the NPDES permit and the reasonable alternatives. This EA evaluates only the proposed permit conditions that are less stringent than the current permit. Changes that make the permit more stringent do not need to be assessed since they will not adversely affect the environmental resources in comparison to the current conditions. The affected environment described herein is limited to water resources, aquatic life, and human health. EPA dos not expect other environmental resources, such as soils, vegetation, wildlife, air quality, land use, and socioeconomics to be affected in any way by the proposed action. Descriptions of these resources can be found in previous environmental assessments associated with the Red Dog Mine, to which the reader is referred (USEPA/DOI 1984; USEPA 1993; USEPA 2003). EPA prepared this EA in compliance with NEPA regulations of the Council on Environmental Quality (40 CFR Parts 1500-1508) and EPA's NEPA implementing regulations (40 CFR Part 6).

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVE

This chapter describes the proposed action and an alternative to the proposed action.

2.1 Proposed Action and Alternative

2.1.1 Alternative 1 - Proposed Action: Renew the NPDES Permit with Changes

The proposed action is to renew Teck Cominco's NPDES permit for the Red Dog Mine with changes consistent with State of Alaska Water Quality Standards. The proposed permit renewal contains the following requirements and/or changes that are less stringent than the current permit:

1. If EPA approves the SSC of 1,500 mg/L for TDS for the Arctic grayling spawning period in Mainstem Red Dog Creek, the permittee would be required to maintain in-stream TDS concentration at or below 1,500 mg/L at the edge of the mixing zone, including during spawning periods (varied from as few as 6 days to as long as 11 days). If EPA does not approve the SSC, ADEC may allow for an adjustment up to 1,000 mg/L TDS during

spawning periods. If the adjustment is not approved, then EPA will require 500 mg/L TDS limit at the edge of the mixing zone during spawning.

2. Remove the 3,900 mg/L end-of-pipe TDS limit for Outfall 001.

3. ADEC has proposed a mixing zone for cyanide. EPA determined that there is no reasonable potential for the effluent to cause or contribute to an exceedance of the standard outside the mixing zone, therefore, no limit is necessary. Weekly monitoring for cyanide remains unchanged. The proposed reissued permit requires the use of the Weak Acid Dissociable (WAD) cyanide analytical method.

4. ADEC has not re-certified the site-specific criterion used for zinc in the current permit, which contained a zinc limit based on the natural condition site specific-criteria provided in ADEC's 1998 CWA Section 401 certification of the permit of 210 µg/L. Therefore, the state-wide criteria of 269 µg/L would be utilized to calculate the permit effluent limit.

2.1.2 Alternative 2: Renew the NPDES Permit with No Changes

Under the alternative, EPA would not change any provisions in the 1998 NPDES permit. Instead, EPA would:

1. Retain the 1998 effluent limits for TDS of 170 mg/L (monthly average) and 196 mg/L (daily maximum) during grayling spawning in Mainstem Red Dog Creek.

2. Retain an effluent limit of 3,900 mg/L TDS at end-of-pipe.

3. Retain effluent limits for cyanide of 9 mg/L daily max and 4 mg/L monthly average. Compliance with the cyanide limits would be determined by the total cyanide analytical method.

3.0 The Affected Environment

As noted in Section 1.3, the scope of this EA includes only potential impacts from the proposed reissuance of the existing NPDES permit, and the alternative. These actions would affect only water resources, aquatic life, and human health. Therefore, the discussion of the affected environment in this EA is limited to these resources. USEPA/DOI 1984, and USEPA 1993 contain discussions of the potential impacts of the Red Dog Mine on other resources, such as soils, vegetation, air quality, land use and socioeconomics, which this proposed action does not affect. Figures 1 and 2 show the locations of monitoring stations where stream flow and water quality data have been collected.

3.1 Water Resources

3.1.1 Hydrology and Stream Flow

Hydrology information is detailed in USEPA/DOI 1984. Seasonal stream flows vary significantly in the Arctic environment of the mine site, with virtually all flow occurring in the five-month period from spring thaw in May to winter freeze in October. Stormwater runoff can vary significantly depending on topography, degree of soil saturation, and depth to the frozen layer. Small tributary streams typically freeze to the bottom in the winter months, whereas larger rivers can continue to flow beneath an ice covering.

Red Dog Creek. Red Dog Creek, which drains the western foothills of the DeLong Mountains, including the Red Dog Mine site, flows into Ikalukrok Creek, a major tributary of the Wulik River (Figure 1). The stream has two major tributaries (Middle Fork and North Fork) that combine to form Mainstem Red Dog Creek. A third tributary, the South Fork, was impounded to form the tailings impoundment and no longer flows to its natural confluence with the Middle Fork. The Red Dog Mine facilities, including the Red Dog Mine pit and Red Dog Creek diversion, are contained within the drainage areas of Middle and South Fork Red Dog Creek.

North Fork Red Dog Creek drains approximately 41 km^2. The stream is typically from 7 to 15 meters wide and from 0.1 to 2 meters deep (ADNR-OHMP, 2005). It is characterized by abundant streamside vegetation, riffles and pools that flow over substrate of gravel and boulders. Middle Fork Red Dog Creek drains approximately 12 km^2. This segment is a meandering channel that is 3 to 10 meters wide and 0.03 to 0.45 meters deep. Mainstem Red Dog Creek drains approximately 64 km^2 (ADF&G, 1999). Mainstem Red Dog Creek flows across a substrate mostly of gravel, cobbles, and small boulders. This creek meanders and has widths ranging from 3.5 to 18 meters wide and depth between 0.06 to 2.5 meters.

Figure 3 shows the mean daily flow in Mainstem Red Dog Creek, as measured at Station 10 from May – October 2004. The creek is generally frozen during winter months. The creek flow peaks at slightly over 200 cfs during ice breakup in May.

Table 2 shows the minimum, maximum, and median flows for the outfall, station 10, station 150, station 160 (located in Ikalukrok Creek below Dudd Creek), and station 2 (in the Wulik River below the confluence of Ikalukrok Creek). The flows represent data collected from 2003 through 2005. The flow at Station 10 ranges from 1 to 766 cubic foot per second (cfs) with a mean value of 74 cfs (late summer storms can cause fluctuating high flows ranging up to 766 cfs). Approximately 16 percent of the mean flow is from the mine outfall discharge.

Table 2. Flow Rates in cfs
May – October, 2003-2005

	Outfall Discharge	Station 10 (Mainstem Red Dog Creek)	Station 150 (Ikalukrok Creek below Mainstem Red Dog Creek)	Station 160 (Ikalukrok Creek below Dudd Creek)	Station 2 (Wulik River below Ikalukrok Creek)
Minimum	0.0	1	4	11	65
Maximum	31	766	2402	4057	21600
Mean	12	74	284	467	2235
Count	436	448	448	437	448

Ikalukrok Creek. Ikalukrok Creek flows into the Wulik River which, in turn, flows to the Chukchi Sea. Near the headwaters of Ikalukrok Creek, the stream flows through areas of natural mineralization (ADF&G, 1999) and is impacted by natural seepage of minerals from Cub Creek (ADNR-OHMP, 2005a) located in upper Ikalukrok Creek approximately 1 mile upstream of the confluence with East Fork Ikalukrok Creek.

Ikalukrok Creek above the confluence with Mainstem Red Dog Creek drains approximately 150 km^2. This segment, which has not been disturbed by human activity, has a substrate of cobbles, gravel, and rocks. At Station 9, in Ikalukrok Creek above the confluence of Mainstem Red Dog Creek the rocks in the stream bed are frequently stained orange from naturally occurring iron precipitate (ADF&G, 1999). In this reach, Ikalukrok Creek is typically 2 to 7 meters wide (up to 20 meters during high flow), with depths of 0.15 to 1.2 meters. Below the confluence with Mainstem Red Dog Creek, Ikalukrok Creek is a comparatively fast-flowing stream with a substrate of small cobbles and gravel. ADF&G (1999) reported a dense growth of filamentous algae and iron precipitate on the stream bottom at Station 8 (located in Ikalukrok Creek just below the confluence of Mainstem Red Dog Creek, see figure 1). Gravel bars are exposed during low flow. Ikalukrok Creek below the Dudd Creek confluence ranges in wetted-width from 3.5 to 40 meters and in depth from 0.3 to 1.2 meters. The substrate in this location consists of small to medium sized gravel (ADF&G, 1999).

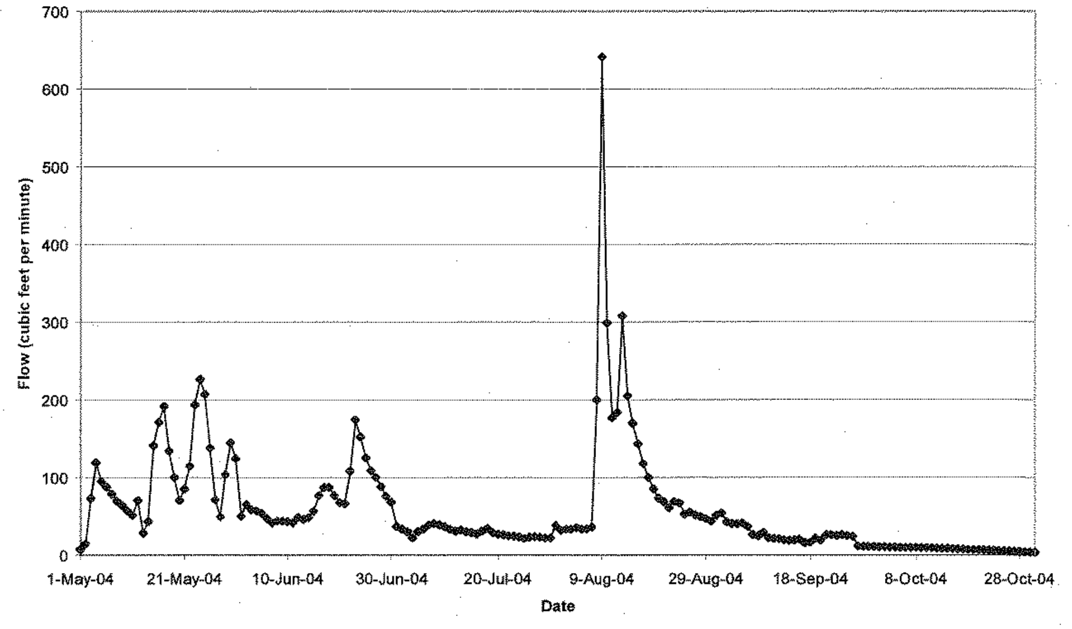
Average seasonal flow at Station 150, in Ikalukrok Creek below the Mainstem confluence, is highly variable. Essentially all stream flow occurs from May through October. Due to the presence of shallow permafrost and saturated soils, rapid snowmelt or rainfall results in rapid changes in stream discharge. Surface discharge volume peaks in late May during ice breakup and during summer storms. Peak flow volume may exceed 2,000 cfs during these periods. Flow decreases with the onset of winter (September/October) and by mid-winter the creek is substantially frozen, although intermittent aufeis fields may form from ice pressure. Based on data from years 2003-2005, the flow

at Station 150 ranged from 4 cfs to 2,400 cfs with a mean value of 284 cfs (Table 2). Approximately 4 percent of the mean flow is attributable to the mine outfall discharge.

In Ikalukrok Creek downstream of Dudd Creek at Station 160 (see location on Figure 1), flows generally range between 11 and 4,000 cfs, with a mean flow of 467 cfs. Approximately 3 percent of the median flow is attributable to the mine outfall.

Flow in the Wulik River, as measured for the years 2003-2005 at Station 2 (lower Wulik River below the confluence of Ikalukrok Creek) ranged from 65 cfs to 21,600 cfs with a mean flow of 2,235 cfs. Less than 1% of the mean flow is attributable to the mine outfall.

Figure 3. Mean Daily Flow in Mainstem Red Dog Creek (Station 10), May - October 2004



3.1.2 Surface Water Quality

Elevated metal sulfates in the mine water, which ultimately result in increased levels of TDS downstream of the mine discharge point, originate from oxidation of the naturally occurring metal sulfide mineralization abundant in the district. Metal sulfide oxidation is a naturally occurring process, which explains the high levels of metals in Red Dog Creek prior to mining activity (EVS, 1983). Mining greatly accelerates the oxidation process, however, another significant source of metal sulfides in the mine water is the diversion of the naturally impacted waters historically flowing into Red Dog Creek into the Red Dog Mine wastewater treatment facility.

Teck Cominco treats Red Dog Mine wastewater to reduce metals and other constituents to concentrations required in the NPDES permit. This treatment results in increased TDS concentrations in the effluent that is discharged to the receiving waters. Lime, containing calcium, and sodium sulfide are the primary additives used to remove metals from the wastewater. Based on available analytical data, the effluent TDS concentration in 2005 was between 2,510 mg/L and 4,175 mg/L, with a median concentration of 3,817 mg/L. The approximate percent composition of ions in the effluent TDS was:

Potassium	1.0 %
Bicarbonate/Carbonate/Hydroxide	0.7%
Chloride	0.6 %
Sodium	2 %
Magnesium	1.7 %
Calcium	24.7 %
Sulfate	69.3 %

All of these ions are typically found in natural waters, and with the exception of calcium and sulfate, in roughly the same concentration as the mine effluent. Sulfate and calcium are the predominant ions in this TDS mixture. Table 3 summarizes analytical TDS data for Red Dog and Ikalukrok Creeks since the effective date of the modified permit (August 22, 2003 – 2005).

Table 3. Summary of TDS Concentrations in Red Dog Creek and Ikalukrok Creek Since Effective Date of Permit Modification (August 22, 2003 – 2005)

TDS	North Fork Red Dog Creek (unaffected by effluent)	Mainstem Red Dog Creek		Ikalukrok Creek, below Mainstem Red Dog Creek	Ikalukrok Creek, below Dudd Creek
	Station 12	Station 10	Station 151[a]	Station 150[b]	Station 160
Minimum	50	166	154	70	78
Maximum	400	1370	1410	630	450
Mean	270	772	826	337	289
Count	24	51	96	98	49

See Figures 1 and 2 for station locations.

[a] Edge of Mixing Zone 1.

[b] Edge of Mixing Zone 2.

Red Dog Creek. In general, higher concentrations of TDS in Red Dog Creek occur when mine effluent flow volumes are high compared to the stream flow. Because of the mine effluent, the concentrations of TDS are substantially higher in Mainstem Red Dog Creek than upstream in North Fork Red Dog Creek.

The data in Table 3 show that TDS concentrations in Mainstem Red Dog Creek vary substantially under the present discharge conditions. However, there have been no TDS measurements over 1,500 mg/L since the effective date of the modified permit.

Decreases of metal loads at the source insure reduced loads and concentrations at all points downstream. ADNR-OHMP (2005) has documented the reduced concentrations from pre-mining levels. Figures 4, 5, and 6 compare median pre-mining concentrations of cadmium, lead and zinc to post-mining concentrations in the Mainstem Red Dog Creek.

Figure 4. Mainstem Red Dog Creek Median Cadmium Concentrations
Pre-Mining and 1999-2004

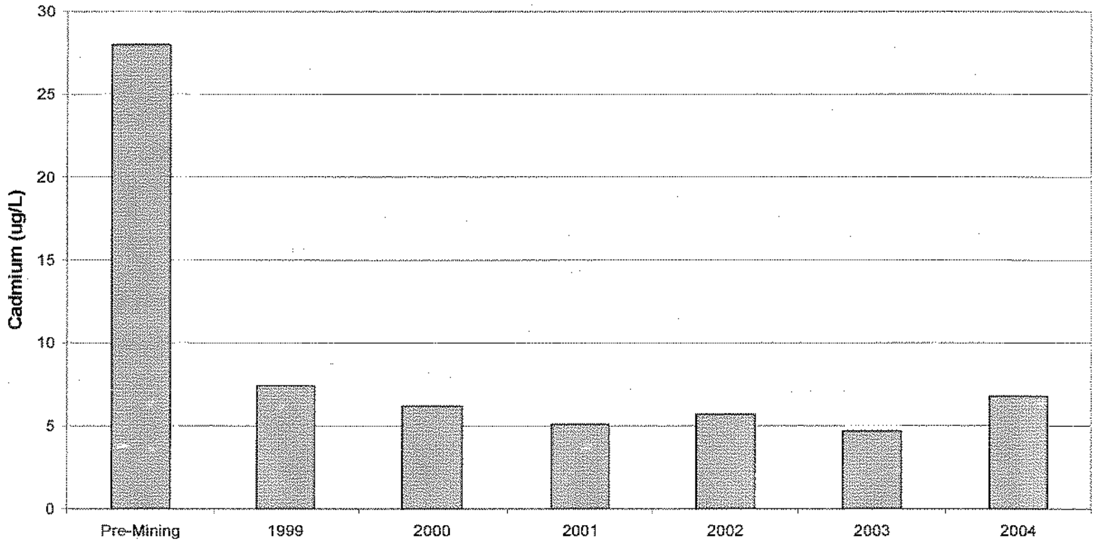


Figure 5. Mainstem Red Dog Creek Median Lead Concentrations
Pre-Mining and 1999-2004

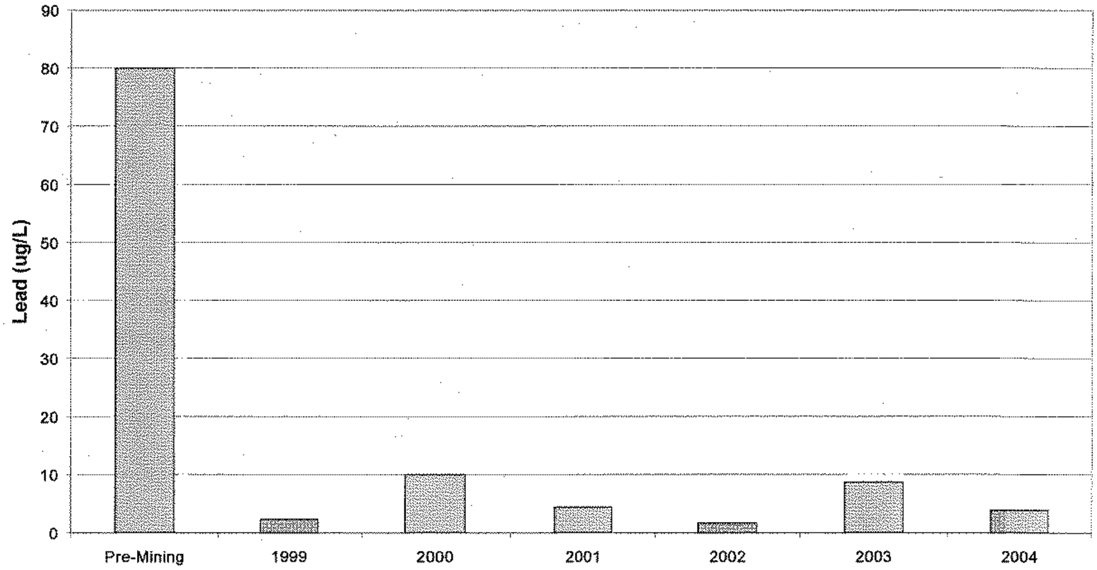
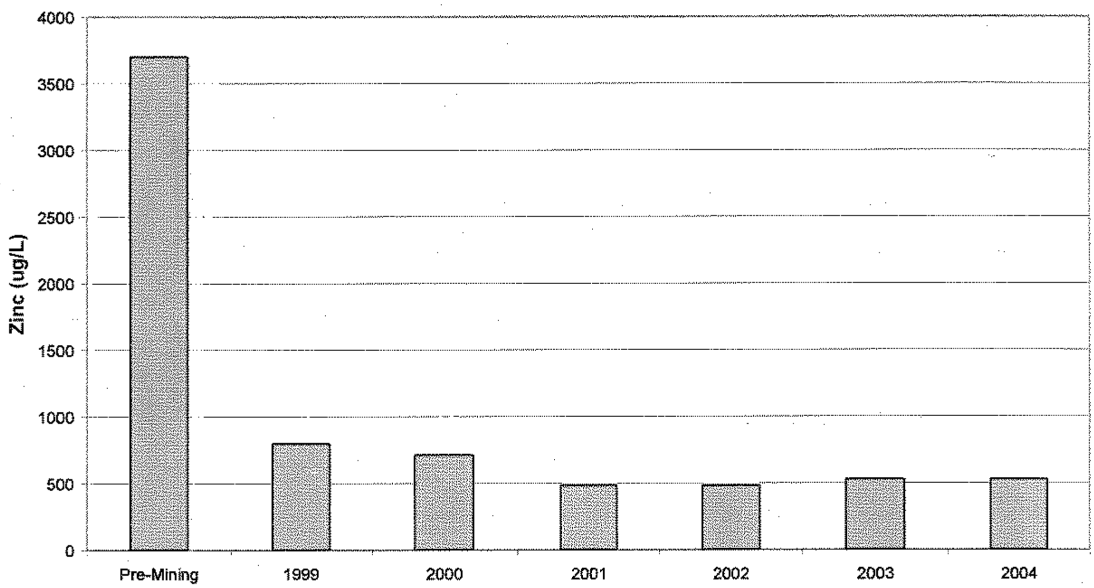


Figure 6. Mainstem Red Dog Creek Median Zinc Concentrations
Pre-Mining and 1999-2004



Ikalukrok Creek. As can be seen from Table 3, in general, the mean concentrations of TDS at Stations 150 and 160 are less than half the concentration in the Mainstem Red Dog Creek. None of the measurements at Station 150 exceeded the TDS criterion of 1,000 mg/L TDS, and none of the measurements at station 160 exceeded the TDS criterion of 500 mg/L that is applicable during salmonid spawning periods.

3.2 Aquatic Resources

Aquatic resources and fisheries have been described in several ADF&G and ADNR publications (ADF&G 1990; 1992; 1993; 1994; 1996a,b; 1998; 1999; 2000; 2001a; 2002a; ADNR-OHMP 2004; 2005). In addition, aquatic resources were described in earlier baseline reports (EVS and Ott Water Engineers 1983; EPA/DOI 1984; Dames and Moore 1981, 1983).

3.2.1 Fish

<u>Arctic grayling (*Thymallus arcticus*)</u>
When break-up occurs (usually in May), adult Arctic grayling migrate upstream in Ikalukrok Creek to Mainstem Red Dog Creek and into North Fork Red Dog Creek to spawn. Since mine

development, grayling spawning has been known to occur in Mainstem Red Dog Creek when water temperatures remain colder in North Fork Red Dog Creek for an extended period of time relative to the Mainstem. Spawning activity begins when water temperatures reach approximately 4°C, for a period that varies from as few as 6 days to as long as 11 days. Fry hatch in late June and rear in Mainstem Red Dog Creek and North Fork Red Dog Creek until fall. Grayling feed on benthic invertebrates and terrestrial insects. In late August or September, young-of-the-year and adults migrate downstream to overwintering areas in Ikalukrok Creek or the Wulik River. ADF&G and ADNR (2005) have observed significant numbers of grayling young-of-the-year in Mainstem Red Dog Creek in 1995, 1996, 1997, 1999, 2003 and 2004 (ADNR-OHMP, 2005a), suggesting that Arctic grayling spawn in lower Mainstem Red Dog Creek (ADF&G 2002b). Use of Mainstem Red Dog Creek by Arctic grayling adults and young-of-the-year in the past few years appears to be increasing (ADF&G 1998). Increased use is likely related to overall improvements in water quality, increased primary production and increased numbers and diversity of benthic invertebrates (Weber Scannell, 2005).

Dolly Varden (*Salvelinus malma*)

Approximately 90 percent of overwintering Dolly Varden in the Wulik River drainage occur in the Wulik River downstream of the mouth of Ikalukrok Creek (ADF&G 1998). Dolly Varden spawn in the fall and juveniles emerge in the spring. Spawning has been documented in Ikalukrok Creek below Station 160 and near the confluence of Ikalukrok Creek and Dudd Creek and in Dudd Creek. Juvenile distribution is broader than that of adult spawners. Juveniles have been collected in Mainstem and North Fork Red Dog Creek and in Ikalukrok Creek.

Chum salmon (*Oncorhynchus keta*)

Chum salmon are found in Ikalukrok Creek. They spawn in the lower 9.5 mile reach of Ikalukrok Creek below Dudd Creek from late July through August (ADF&G 2002a). The population in this reach increased after the early 1990s, presumably due to the construction of a diversion ditch at the Teck Cominco mine site. The 2001 surveys conducted by ADF&G counted 2,250 adult chum salmon - the highest number since mining began (ADF&G 2002b). ADNR reports that the large number of chum salmon in recent years, particularly 2001 and 2002, are good indications that the population has recovered from the low numbers reported in the early 1990s (ADNR-OHMP, 2005a).

Chinook and Sockeye Salmon

Both chinook and sockeye salmon are rare in the system. Prior to construction of Red Dog Mine, Chinook salmon used Ikalukrok and Dudd Creeks for spawning (Dames and Moore 1983). In 2001, two Chinook salmon were observed on a redd in lower Ikalukrok Creek. No juvenile Chinook salmon have been caught in sampling nets between 1990 and 2003. Townsend and Conley (2004) observed 56 adult Chinook salmon in a side channel slough in lower Ikalukrok Creek in August 2004. Water temperature measurements (Ott and Townsend, 2005) indicate that the slough

containing the Chinook salmon is dominated by groundwater with little influence from Ikalukrok Creek water or the Red Dog Mine effluent. In 2004, juvenile Chinook salmon were observed near Dudd Creek and in Anxiety Ridge Creek. In 2005, minnow traps were fished in lower Ikalukrok for the first time since 1990. Six juvenile Chinook salmon were captured in these minnow traps (Ott and Townsend, 2005). The Alaska Department of Environmental Conservation reports that the Chinook salmon in Ikalukrok Creek do not represent a significant breeding population (ADEC, 2003).

In field surveys conducted in 1997, eight sockeye salmon were observed in lower Ikalukrok Creek (ADF&G 2002b). The only presence of sockeye salmon in Mainstem Red Dog Creek was the observation of a single male carcass in 2003 (Scannell, 2003). Sockeye salmon use and abundance in the Ikalukrok Creek drainage is probably limited.

Slimy sculpin (*Cottus cognatus*)

Slimy sculpin have been observed in the North Fork and were caught for the first time in the Mainstem of Red Dog Creek in 1995. Slimy sculpin also occur in Ikalukrok Creek.

Table 4 summarizes fish presence by life history stage in the major stream segments. Fish have not been observed in the Middle Fork Red Dog Creek at any time, including the pre-mining period. The winter distribution of all fish species appears to be limited to Ikalukrok Creek downstream of the confluence with Dudd Creek and in the Wulik River. There are no threatened or endangered species or critical habitats in or near the waters that may be affected by the proposed changes in the renewed NPDES permit.

Table 4. Fish Use in the Project Area

Creek Segment	Spawning	Rearing	Juvenile Outmigration
North Fork Red Dog Creek	AG	AG, DV, SS	AG, DV, SS
Middle Fork Red Dog Creek	--	--	--
Mainstem Red Dog Creek	AG	AG, DV, SS	AG, DV, SS
Ikalukrok Creek upstream of Red Dog Creek [a]	AG [c]	AG, DV, SS	AG
Ikalukrok Creek between Red Dog Creek and Dudd Creek	AG	AG, DV	AG, DV, SS